

# Tire Technology for Future Electric Vehicles

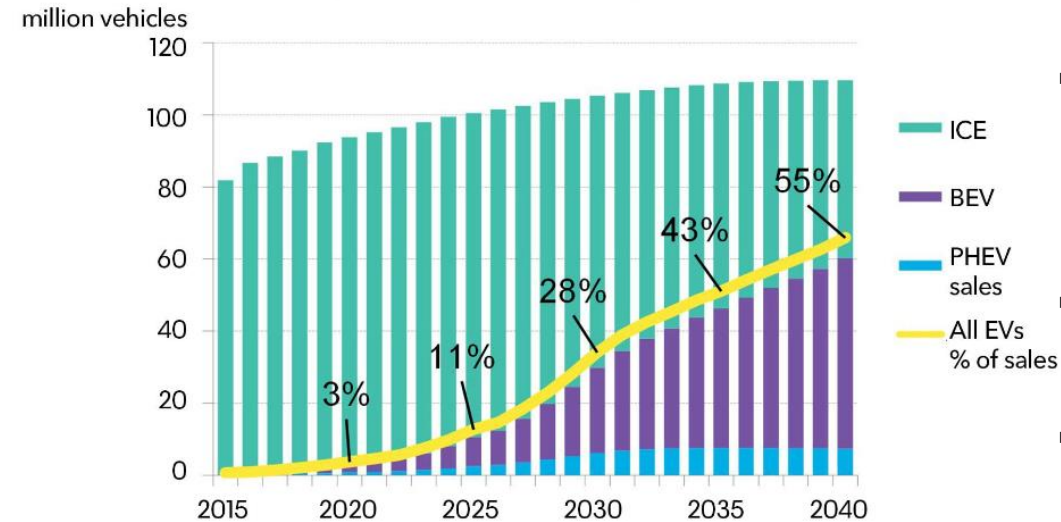
2019. 5. 9  
Hankook Tire



- **Introduction**
- **Electric Vehicle Characteristics**
- **Requirements for EV Tires**
- **EV Tire Technology**

# EV Market Share Prediction

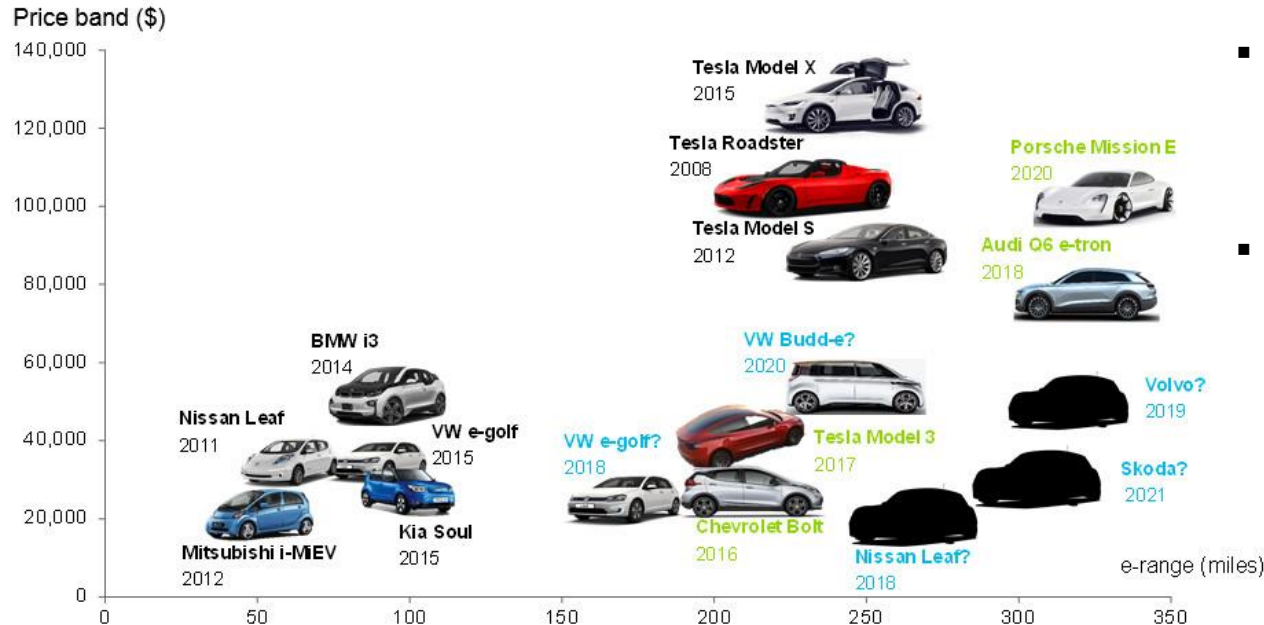
Annual global light duty vehicle sales



Source: Bloomberg New Energy Finance

- By 2040, 55% of new car sales and 33% of the global car fleet will be electric.
- China will lead this transition, with sales there accounting for almost 50% of the global EV market in 2025 and 39% in 2030.
- EVs become price competitive on an unsubsidized basis beginning in 2024.
- WLTP (CO<sub>2</sub>: 2015 130g/km → '2020 95g/km)  
In Year 2021, the total penalty: 4.5 bil EU

# Electric Vehicle Characteristics – e-Range

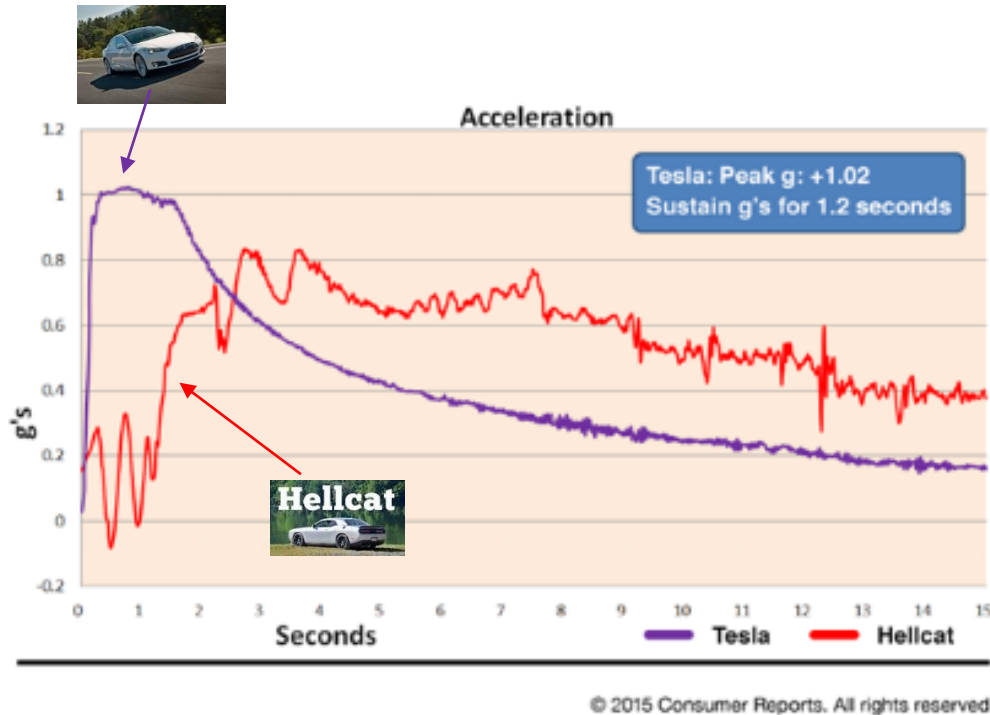


**Note:** Selected US battery electric vehicles (BEV) only. Positions are representative and do not indicate exact prices or range. Back labels = currently available, green labels = forthcoming models with specifications and timeline released. Blue labels = announced but limited details confirmed. Range is based on manufacturers statements, not on any specific test cycle.

**Bloomberg**  
NEW ENERGY FINANCE

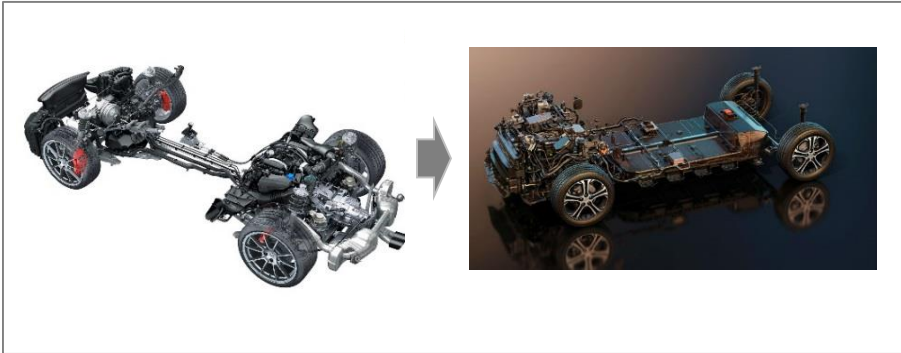
- e-Range is the primary concern for battery electric vehicles.
- Tire rolling resistance is responsible for 30% of energy consumption of EVs, which is much higher than that of ICEVs (7~10%).

# Electric Vehicle Characteristics – Traction

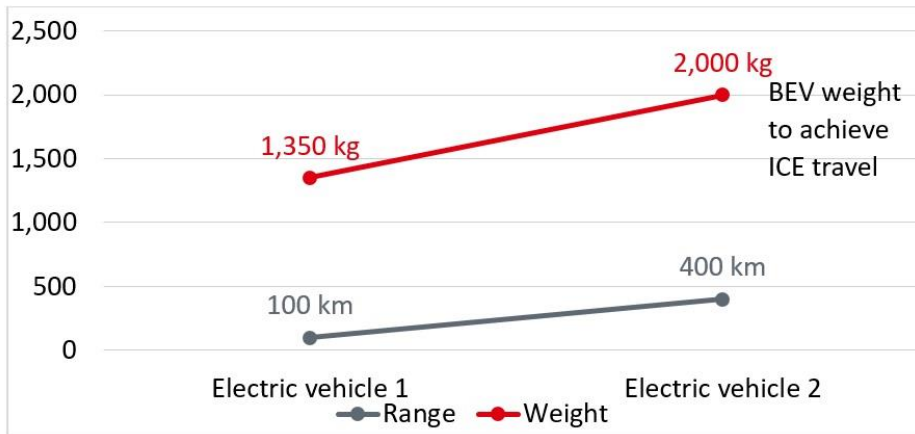


- Electric motor can give higher initial torque compared to internal combustion engine.
- EVs has less delay in acceleration build-up than ICEVs.
- The higher torque may cause torque steer and excessive tire wear.

# Electric Vehicle Characteristics – Weight



- Vehicle weight increases by 15% due to large size batteries.
- Increased performance of BEVs is tied to increase in battery weight, as batteries are getting larger to accommodate longer-range driving.
- The increased weight affects vehicle performances such as braking, handling as well as wheel design.

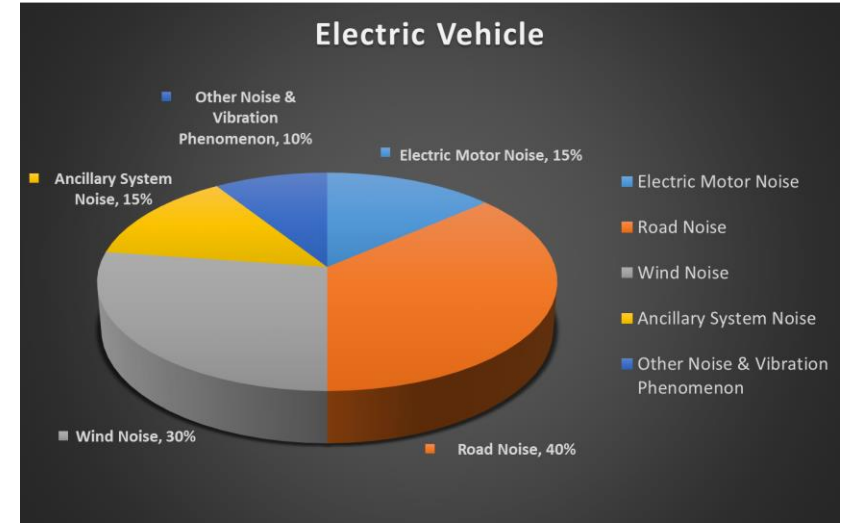
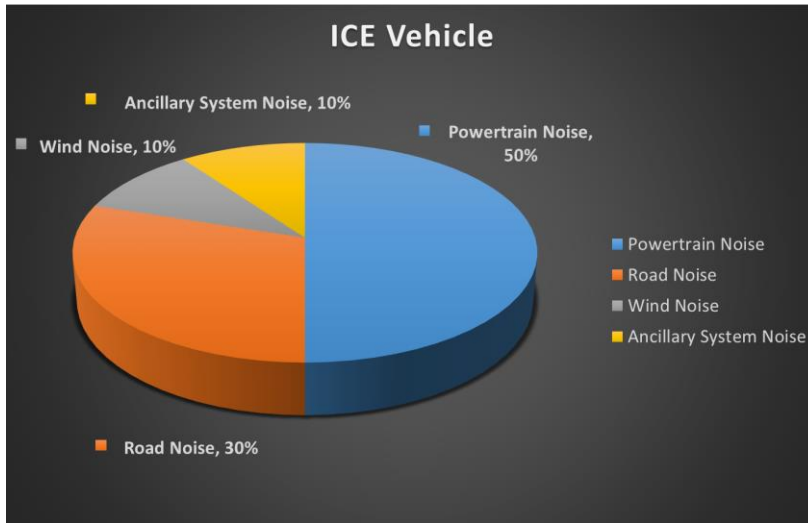


Source: Agronomy Research, 2017

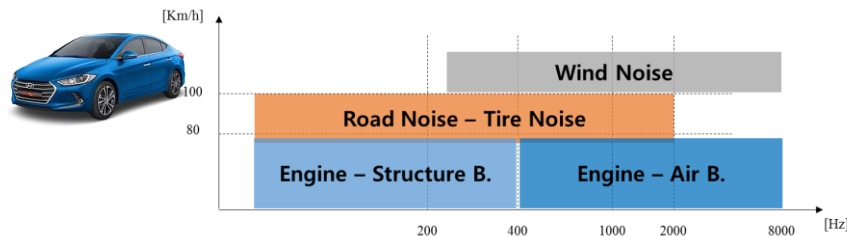


# Electric Vehicle Characteristics – NVH

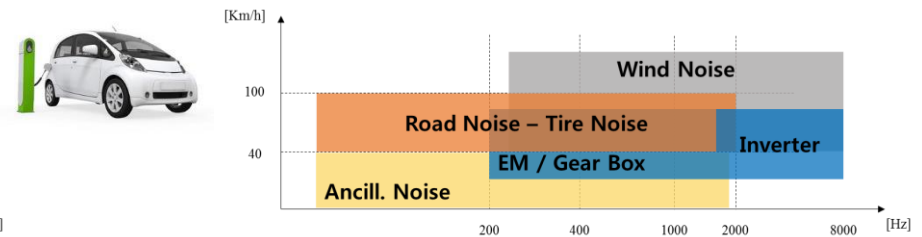
- No Powertrain Noise
- Road Noise, Wind Noise Contribution ↑



**ICEV**



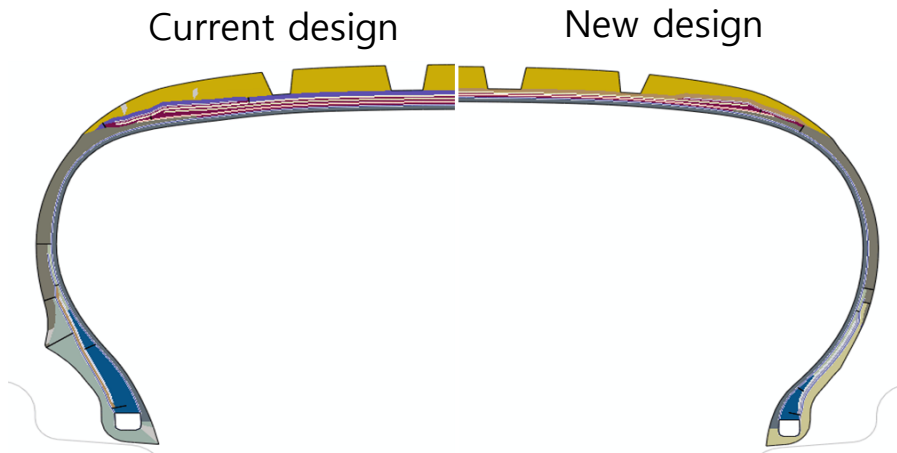
**EV**



Source : Leading the Charge – The Future of Electric Vehicle noise Control  
Greg Goetchius, Sound & Vibration, April 2011

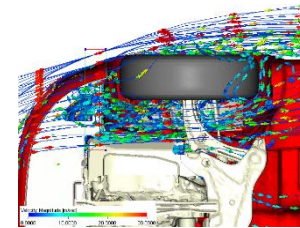
# EV Tire Technology – LRR / Aerodynamics

- **LRR Tire design concept**



- Volume optimization
- Groove depth optimization
- New tread compound with eco-friendly material

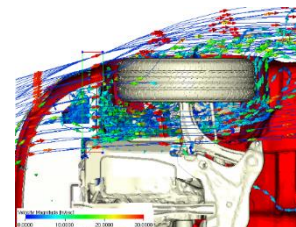
- **Aerodynamics**



## **Smooth Tire**

Drag Contribution from tires

- Front Tires : 9%
- Rear Tires : 4%



## **Patterned Tire**

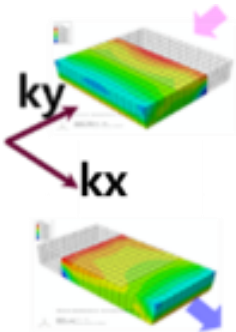
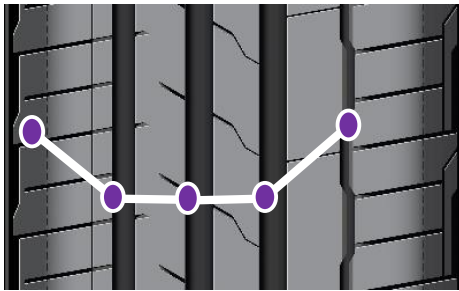
Drag Contribution from tires

- Front Tires : 13%
- Rear Tires : 5%



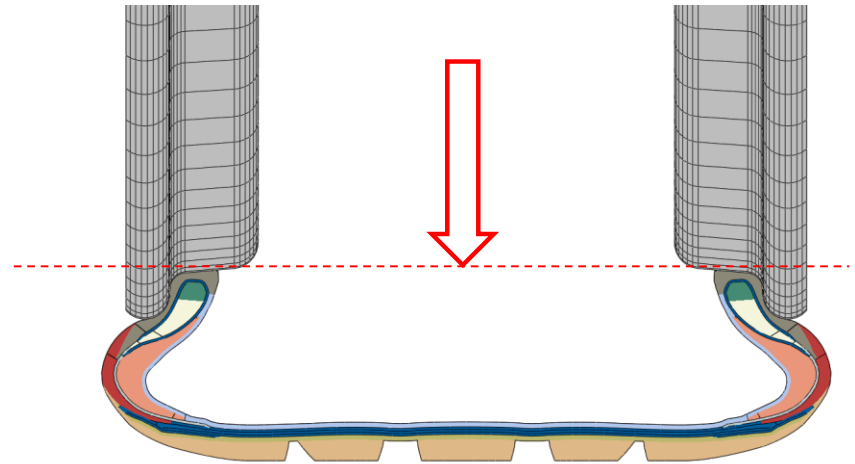
# EV Tire Technology – Traction / Load Capacity

- Higher Block Stiffness (for Higher torque)



- Higher Load Capacity

12~13% increased load  
compared with normal load



# EV Tire Technology – NVH

- Pattern Technology



Anechoic wall



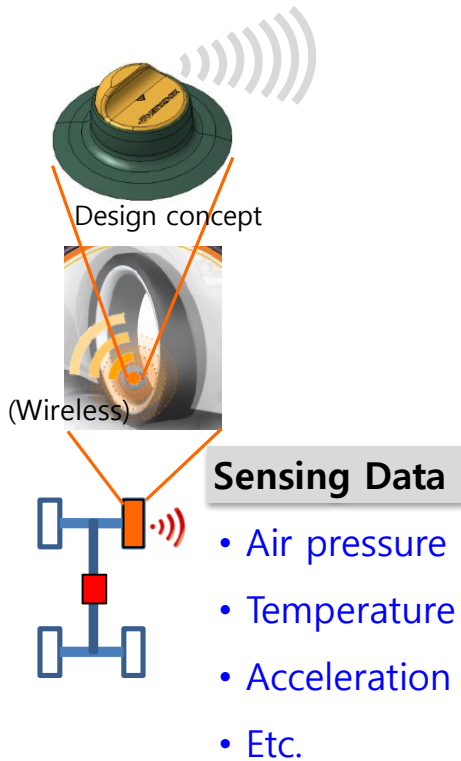
Block Pitch optimization

- Sound Absorber Technology

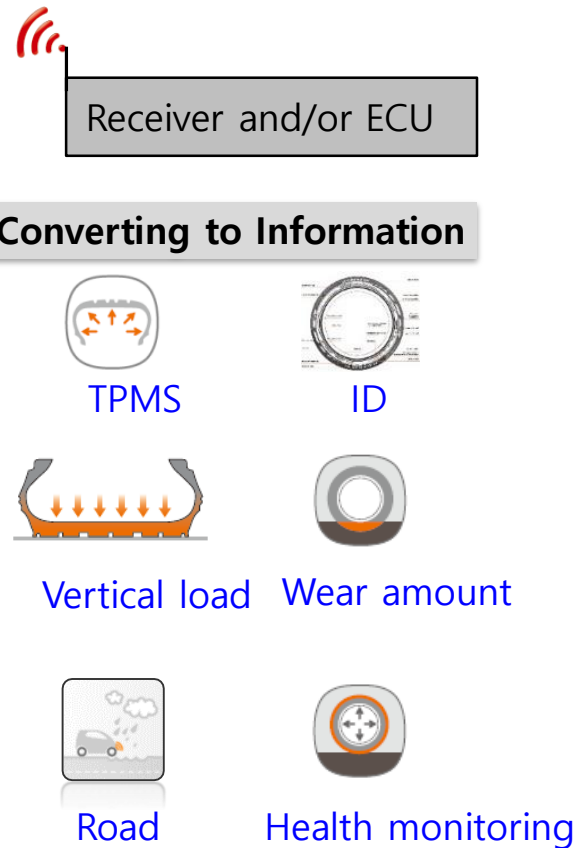


# EV Tire Technology – Intelligent Tire System

## i-Tire Sensing



## Wireless Comm. and Estimation

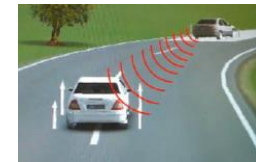


## Application

### Vehicle (Chassis System)



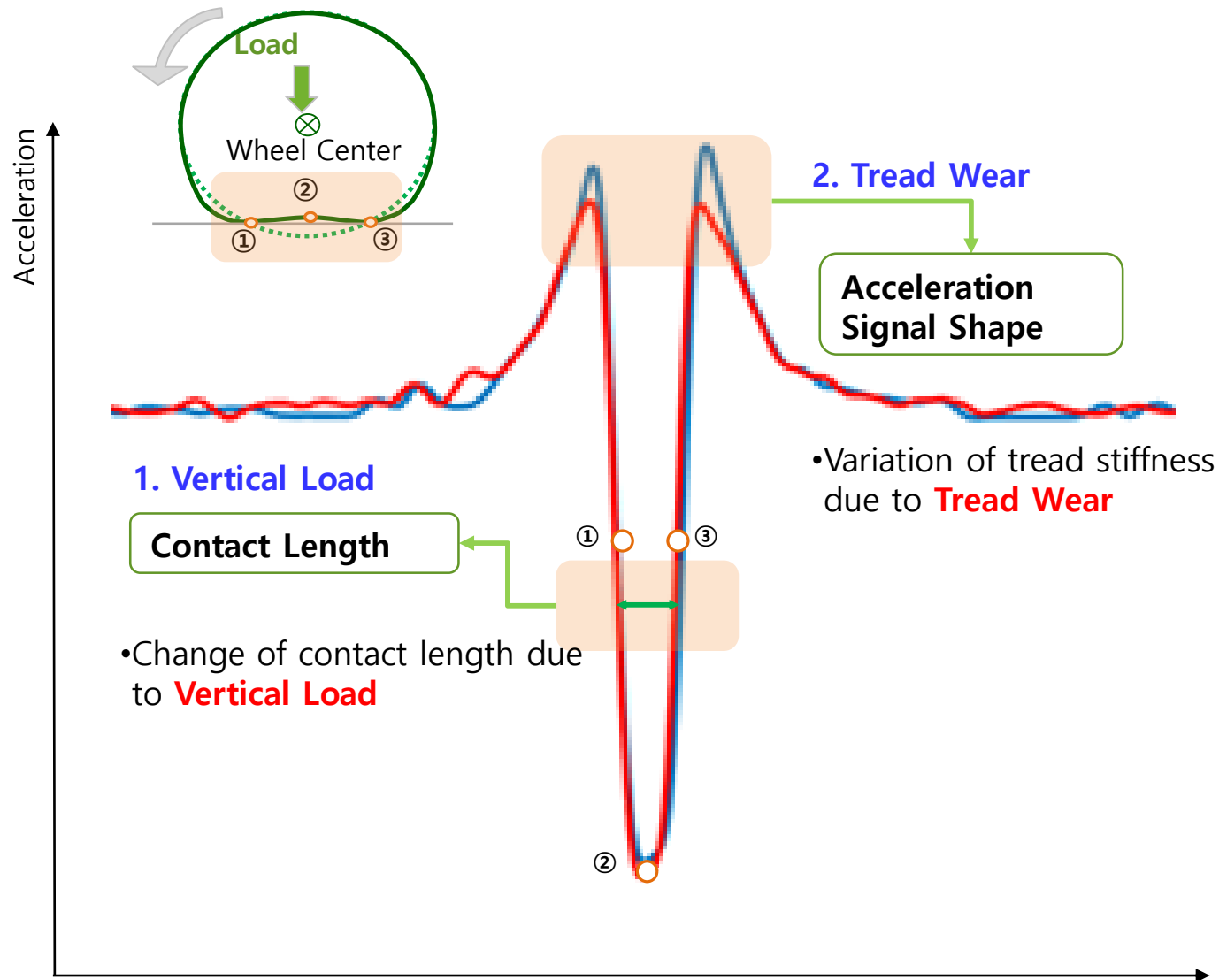
### Telematics (V2V, V2I)



### Driver



# Estimation Technology – Vertical Load & Tread Wear



# Estimation Technology – Road Condition



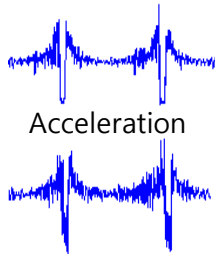
## Input



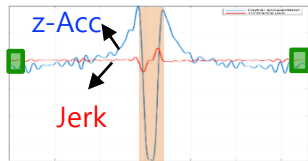
Dry



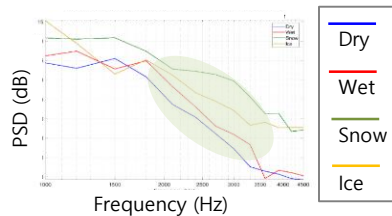
Snow



Acc. Signal

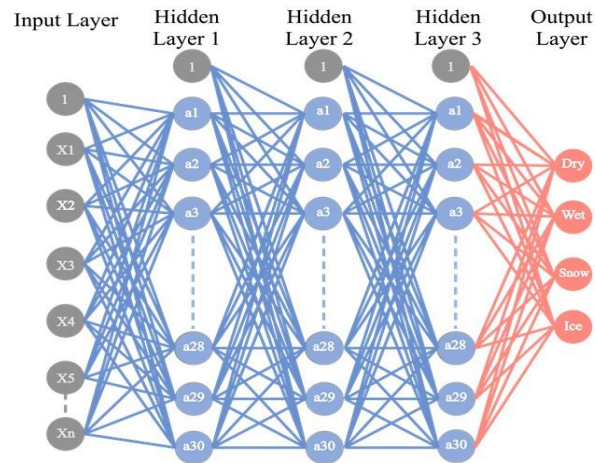


Freq. domain analysis



## Algorithm Development

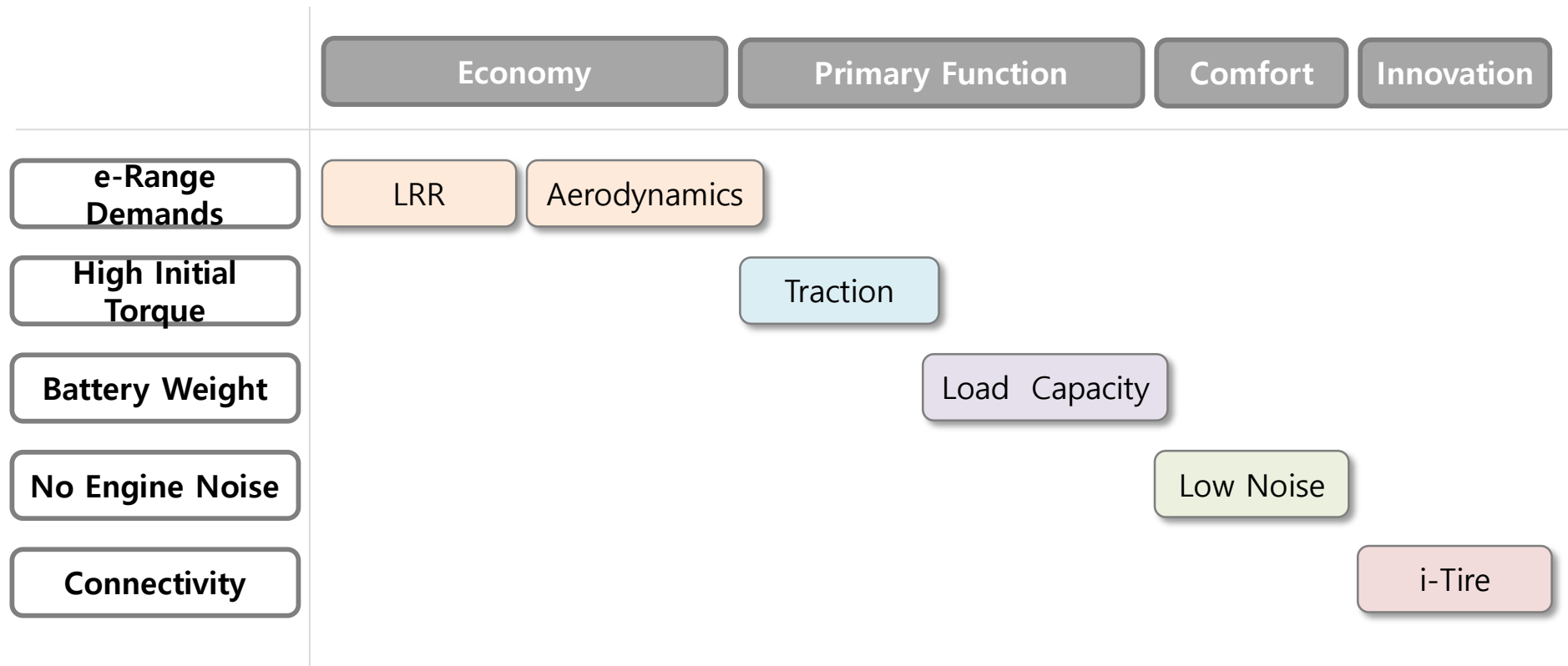
### Machin Learning



## Result

Dry	Ice	Snow	Wet
83.0%	96.2%	95.6%	81.8%
Overall 89.1%			

# Summary of EV Tire Technology





## End of The Document



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